

## **A Motorcycle Chain Tension Adjuster**

### **Background of the Invention**

#### **Field of the Invention**

[0001] This invention relates generally to wheeled vehicles with a flexible power  
5 transmission mechanism such as a chain or belt. More particularly, this invention  
relates to devices for the adjustment of tension in a flexible power transmission  
mechanism.

#### **Description of Related Art**

[0002] Wheeled vehicles such as motorcycles generally have a drive sprocket or  
10 pulley attached to the drive shaft of the motor. The drive sprocket or pulley is  
then coupled to a flexible power transmission mechanism. In the case of the  
drive sprocket, the flexible power transmission mechanism is a chain.  
Alternately, in the case of the drive pulley, the flexible power transmission  
mechanism is a belt. The chain or belt is then coupled to a sprocket or pulley  
15 affixed to driven wheel. The driven wheel is mounted to an axle that is secured  
to the frame of the motorcycle. Generally the frame of the motorcycle has a  
forked swing arm. The axle is secured to the swing arm. The swing arm allows  
vertical movement of the driven wheel. This vertical movement is dampened by  
a shock absorbing system connecting the swing arm and a rigid portion of the  
20 frame.

[0003] As is known in the art, the chain or belt must have correct tension to efficiently transfer power from the motor to the driven wheel. Motorcycles such as those manufactured by Yamaha Motor Corporation, USA, Kawasaki Motors Corp. U.S.A., American Suzuki Motor Corporation, Ducati Motor Holding S.p.A., and other motor cycle manufacturers integrate a chain tensioner or puller with the driven wheel of their motor cycles. The chain tensioner is coupled to the forks of the swing arm and is placed in a recessed axle slot of the forks. The chain tensioner is attached to the axle of the driven wheel.

[0004] In many of the current models of motorcycle, the chain tensioner is placed forward of the driven axle. The chain tensioner pushes the axle within an axle bore that is opened within the recessed guide of the forks. The chain tensioner is often adjusted by rotating a threaded stud captivated in a housing placed in the recess guide and secured to the forks. The threaded stud generally has a hexagonal head that is adjusted with a standard wrench. For motorcycles involved in "off-road" touring or racing, the chain tensioner often becomes fouled with mud and debris. This makes the adjustment difficult. Further, the size of the hexagonal head of the threaded stud is normally small and it is difficult to perform the adjustment during a race or in an "off-road" environment.

[0005] U. S. Patent 6,450,282 (Gogo, et al.) describes a swing-arm support structure for a motorcycle. The swing-arm illustrated shows a slide adjuster mechanism for adjusting the tension of a chain of a motorcycle.

[0006] U. S. Patent 5,524,725 (Schantzen) illustrates a chain drive that has an automatic chain tension adjustor.

[0007] U. S. Patent 5,337,849 (Eavenson Sr., et al.) details a mechanism for mounting an axle to a vehicle. An adjustable tensioning mechanism includes a bolt and nut for shifting the second axle housing with respect to the first axle housing to thereby adjust the tension in the chain.

[0008] U. S. Patent 5,049,114 (Hayden) describes a self-adjusting chain tensioning device made up of a spring loaded rubbing block that is in continuous contact with the chain.

10 [0009] U. S. Patent 4,616,729 (Kasai) details a transmission chain adjuster for motorcycles. An arrangement is provided for adjusting the tension in each of two chains and one of these adjusting mechanisms moves the pivot point of the trailing arm relative to the frame.

15 [0010] U. S. Patent 4,237,744 (Jolly) describes a chain tension adjusting device using a cam mounted within a sleeve that moves a driven wheel axle on a fork frame.

[0011] U. S. Patent 4,061,050 (Bolger) illustrates a compensating mechanism to provide constant tension between a driving sprocket and a driven sprocket of a motorcycle.

[0012] U. S. Patent 5,240,087 (Parker) describes a one-sided rear swing arm suspension system for a motorcycle with a chain-driven rear wheel. The tension of the drive chain may be adjusted without affecting the ride height of the motorcycle by an adjustment yoke that moves the axle longitudinally on the swing arm by means of an adjustment stud extending from the swing arm, and a corresponding adjustment nut entrapped in the neck of the yoke.

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[0013] U. S. Patent 5,964,312 (Maldonado) has a combination suspension swing arm and light assembly also serving to cover the axle nuts and axle adjustment screws for a motorcycle. The lenses are removable to expose both axle nuts and axle adjustment screws, permitting the full adjustment of both.

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## Summary of the Invention

[0014] An object of this invention is to provide a tension adjusting device that adjusts the tension of a flexible power transmission mechanism for wheeled vehicles such as motorcycles.

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[0015] Another object of this invention is to provide a tension adjusting device that replaces the original equipment tension adjusting device that has been attached to an axle member of a driven wheel of a vehicle and coupled to a forked frame member to adjust tension of a flexible power transmission mechanism that transfers power from a drive shaft of the wheeled vehicle to the driven wheel.

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[0016] To accomplish at least one of these objects, a tension adjusting device has a first tension adjuster joined to a first side of the axle member and a second tension adjuster joined to a second side of the axle member. The first tension adjuster includes a first adjustment plate. The first adjustment plate has a first dimension to slidably engage a guide recess of a first fork of the forked frame member and a second dimension sufficient to support a first axle fastener to the axle member to the first adjustment plate. The first adjustment plate further includes an extending member that extends over an end of the first fork. An axle bore is drilled through the first adjustment plate such that the first side of the axle member may pass through the first adjustment plate. The first side of the axle member receives the first axle fastener to secure the axle member to the first adjustment plate and couple the first adjustment plate to the first fork of the forked frame member. A capturing recess is let into the first adjustment plate to secure the first axle fastener to prevent movement of the first axle fastener during the coupling of the driven wheel. The first adjustment plate has an adjustment bore drilled through the extending member and aligned with the end of the first fork. A first adjustment stud is affixed through the adjustment bore to the first adjustment plate such that the adjustment stud is in contact with the end of the first fork to allow the axle member of the driven wheel to move in an adjustment slot within the guide recess to adjust the tension of the power transmission mechanism.

[0017] The second tension adjuster has a second adjustment plate with a first dimension to slidably engage a guide recess of a second fork of the forked frame

member and a second dimension sufficient to support a second axle fastener to the axle member to the second adjustment plate. The second adjustment plate further includes an extending member that extends over an end of the second fork. An axle bore is drilled through the second adjustment plate such that the second side of the axle member may pass through the second adjustment plate. 5 The second side of the axle member receives the second axle fastener to secure the axle member to the second adjustment plate and couple the second adjustment plate to the second fork of the forked frame member. The second adjustment plate has an adjustment bore drilled through the extending member and aligned with the end of the second fork. A second adjustment stud is affixed 10 through the adjustment bore to the second adjustment plate such that the adjustment stud is in contact with the end of the second fork to allow the axle member of the driven wheel to move in an adjustment slot within the guide recess to adjust the tension of the power transmission mechanism.

15 [0018] The adjustment bores of the first and second adjustment plates may be threaded. Alternately, each adjustment bore may have a captivating nut secured to the first and second adjustment plates within the adjustment bores to accept the first adjustment stud. The first and second adjustment studs may be threaded and each includes a securing nut. The securing nut locks the first and 20 second adjustment studs respectively to the first and second adjustment plates, when the first and second adjusting studs have moved the driven wheel such that the flexible power transmission mechanism has the final tension.

[0019]        The first and second adjustment plates each include at least one guide marking placed to insure that the axle member is oriented with respect to the forked frame member. In tensioning the flexible power transmission mechanism, one of the adjustment studs is rotated to move the axle member within the adjustment slot of the forks of the forked frame member. When the flexible power transmission mechanism is at the final tension, the location of the guide marking is noted and the other adjusting stud is rotated to move the axle member to align with guide marking.

[0020]        In the preferred embodiment of this invention, the flexible power transmission mechanism is a chain and the chain is engaged with teeth of a sprocket coupled to the driven wheel. However, in an alternate embodiment of this invention, the flexible power transmission mechanism is a belt and the belt is placed on a pulley coupled to the driven wheel.

[0021]        The first and second adjustment plates are formed of an aircraft grade aluminum. Conversely the materials for the first and second adjustment plates may be steel, titanium, or carbon epoxy.

[0022]        An original equipment tension adjusting device is replaced by removing the original equipment tension adjusting device from the forked frame member and the axle member. The replacement tension adjusting device is installed on axle member. The driven wheel with the replacement tension adjusting device is placed between the first and second fork of the forked frame member. The flexible power transmission mechanism is coupled to the driven wheel. The

placement of the driven wheel is modified such that the extending members of the first and second adjustment plates are aligned respectively with the ends of first and second ends of the forked frame member and the flexible power transmission mechanism has a preliminary tension. The first and second  
5 adjustment studs are varied to move the driven wheel incrementally to adjust the flexible power transmission mechanism to the final tension.

### **Brief Description of the Drawings**

- [0023] Figs 1a – 1c are respectively the front, top and side plan views of the first tension adjuster of the tension adjusting device of this invention.
- 10 [0024] Figs. 2a – 2d are respectively front, top and two side plan views of second tension adjuster of the tension adjusting device of this invention.
- [0025] Figs 3a – 3b are respectively front and top plan views of the first tension adjuster of the tension adjusting device of this invention illustrating multiple guide marks.
- 15 [0026] Fig. 4 is a partial top view of a motorcycle illustrating a swing arm with the driven wheel showing the placement of the tension adjusting device of this invention.
- [0027] Fig. 5 is a partial side view of a motorcycle illustrating a swing arm with the driven wheel showing the placement of the tension adjusting device of this  
20 invention.



## **Detailed Description of the Invention**

[0028] To make the adjustment of the chain tension of a motorcycle easier than is provided by chain tensioner currently employed, the chain tensioning device of this invention replaces the original equipment chain tensioners. The chain tension device of this invention has two chain tension adjusters that are joined to the axle of the driven wheel of the motorcycle and coupled to it through an adjustment slot within a recessed guide of the forks of the swing arm frame member of the motorcycle. The tension adjusting device permits the adjustment of the chain tension with standard wrenches or sockets and allows for more rapid changes of sprocket gearing. Further, the tension adjusting device pulls the axle rather than pushing the axle as in standard chain tensioner in current usage. Additionally, the tension adjusting device of this invention permits replacement of the chain tensioner in current usage that has stripped threads in the swing arm frame member to which the chain tensioner is secured. The tension adjusting device of this invention is not secured to the swing arm frame member by the threaded bore thus making rethreading of stripped threads unnecessary.

[0029] Refer now to Figs. 1a -1c for a detailed description of the first chain tensioner of the chain tension adjusting device of this invention. The first chain tensioner has an adjustment plate **5** with an extending member **10** formed at right angles to the adjustment plate **5**. The length  $L_1$  of the adjustment plate is sufficient to fit in the recessed guide of one fork of the swing arm frame member of the motorcycle and thus permits the extending member **10** to overlap the end

of the one fork of the swing arm frame member. In the preferred embodiment, the length  $L_1$  of the adjustment plate **5** is approximately 3.000".

[0030] The width  $W_1$  of the adjustment plate **5** is sufficiently wide so that the adjustment plate **5** firmly fits the width of the recessed guide of the one fork. In the preferred embodiment the width  $W_1$  is from approximately 1.50" to approximately 1.60". The extending member **10** has a sufficient height  $T_2$  to allow the extending member **10** to overlap the width of the one fork of the sing arm frame member. In the preferred embodiment, the height  $T_2$  is from approximately 1.050" to approximately 1.125".

[0031] The axle of the driven wheel of the motorcycle is normally smooth for most of its length with only a small threaded region to accept an axle nut for securing the driven wheel to the swing arm frame member. The thickness  $T_1$  of the adjustment plate **5** is designed to be adequately thick to prevent the axle nut from being turned to the bottom of the threaded region. Further, the thickness  $T_1$  is designed to allow the axle nut to just cover the threaded region of the axle and not leave any of the threads of the threaded region of the axle extended beyond the axle nut. This prevents mud and debris from accumulating in the threaded region. In the preferred embodiment, the thickness  $T_1$  is approximately 0.50".

[0032] An axle bore **15** is drilled into the adjustment plate **5**. The axle bore **15** is centered on the width dimension  $W_1$  of the adjustment plate **5** and is placed at a distance from a leading edge **50** of the adjustment plate **5** such that the axle of the driven wheel is essentially centered within the recessed guide of the one fork

of the swing arm frame member while the leading edge is in contact with a forward edge of the recessed guide. The diameter  $d_1$  of the axle bore is sufficiently large to accommodate the diameter of the axle. In the preferred embodiment the diameter  $d_1$  of the axle bore **15** is from approximately 0.875" to approximately 1.070".

[0033] A capturing recess **20** is let into the adjustment plate **5** and is centered on the width dimension  $W_1$  of the adjustment plate **5**. The width  $W_2$  of the capturing recess is determined by the size of the axle nut. In the preferred embodiment the capturing recess has a width of approximately 1.3". The Capturing recess **20** is used to hold the axle nut threaded on one end of the axle from turning when a second axle nut is threaded on a second end of the axle. The length  $L_2$  of the capturing recess is set to allow the axle nut to fit within the capturing recess. In the preferred embodiment, the length  $L_2$  is approximately 1.750". The depth  $T_3$  of the capturing recess **20** is sufficient to hold the one axle nut, but not too deep to have an impact on the strength of the adjustment plate **5**. In the preferred embodiment of the capturing recess **20**, the depth  $T_3$  is approximately 0.175".

[0034] An adjustment bore **30** is drilled in the extended member to accept an adjustment stud **25**. The adjustment stud **25** is centered on the width dimension  $W_1$  of the adjustment plate **5** and essentially centered in the height dimension of the extended member. This location must be set such that the adjustment stud **25** can contact the end of the fork of the swing arm frame member. The adjustment bore **30** has a diameter that can accommodate a captivated nut **35**.

Alternately, if the adjustment bore is to be threaded, the adjustment bore **30** must be the diameter of the adjustment stud **25**. In the preferred embodiment, the adjustment stud is approximately 8mm in diameter. If the captivated nut **35** is employed, the adjustment bore is approximately 0.50" in diameter or of a sufficient diameter to permit a press fit of the captivated nut **35**.

[0035] A securing lock nut **40** is threaded on to the adjustment stud **25**. When the driven wheel is coupled to the forks of the swing arm frame member, the securing lock nut **40** is unthreaded on the adjustment stud **25**. The driven wheel is placed between the forks of the swing arm frame member and set to tension the chain to a preliminary tension. The axle nuts are tightened to hold the placement of the driven wheel. The adjustment stud **25** is then adjusted to move the driven wheel to adjust the chain to a final level. The securing lock nut **40** is threaded to impinge upon the extending member **10** of the adjustment plate **5** and lock the adjustment stud **25** in place.

[0036] The guide marks **45** are placed on the top and bottom surfaces of the adjustment plate **5** and are aligned with the center of the axle bore **15**. The fork of the swing arm frame member will have multiple marks or a similar calibration marking to allow of the axle of the driven wheel to be correctly aligned during the movement to tension the chain. The guide marks **45** are shown at the top and bottom of the adjustment plate **5** but may also be on the front face of the adjustment plate **5**.

[0037] Figs. 2a – 2d provide a detailed description of the second chain tensioner of the chain tension adjusting device of this invention. The second chain tensioner has an adjustment plate **105** with an extending member **110** formed at right angles to the adjustment plate **105**. The length  $L_1$  of the adjustment plate is sufficient to fit in the recessed guide of one fork of the swing arm frame member of the motorcycle and permits the extending member **110** to overlap the end of the one fork of the swing arm frame member. In the preferred embodiment, the length  $L_1$  of the adjustment plate **105** is approximately 3.125".

[0038] The width  $W_1$  of the adjustment plate **105** is sufficiently wide to allow for the adjustment plate **105** to firmly fit the width of the recessed guide of the one fork. In the preferred embodiment, the width  $W_1$  is from approximately 1.50" to approximately 1.60". The extending member **110** has a height  $T_2$  that is sufficient to allow the extending member **110** to overlap the width of the one fork of the swing arm frame member. In the preferred embodiment, the height  $T_2$  is from approximately 1.050" to approximately 1.125".

[0039] The axle of the driven wheel of the motorcycle is normally smooth for most of its length with only a small threaded region to accept an axle nut for securing the driven wheel to the swing arm frame member. The thickness  $T_1$  of the adjustment plate **105** is designed to be adequately thick to prevent the axle nut from being turned to the bottom of the threaded region. Further, the thickness  $T_1$  is designed to allow the axle nut to just cover the threaded region of the axle and not leave any of the threads of the threaded region of the axle extended beyond

the axle nut. This prevents mud and debris from accumulating in the threaded region. In the preferred embodiment, the thickness  $T_1$  is approximately 0.50".

[0040] An axle bore **115** is drilled into the adjustment plate **105**. The axle bore **115** is centered on the width dimension  $W_1$  of the adjustment plate **105** and is placed at a distance from a leading edge **150** of the adjustment plate **105** such that the axle of the driven wheel is essentially centered within the recessed guide of the one fork of the swing arm frame member while the leading edge is in contact with a forward edge of the recessed guide. The diameter  $d_1$  of the axle bore is sufficiently large to accommodate the diameter of the axle. In the preferred embodiment, the diameter  $d_2$  of the axle bore **115** is from approximately 0.875" to approximately 1.070".

[0041] There is no capturing recess let in the into the adjustment plate **105**. The axle nut **315** is free to be rotated with a wrench in order to tighten the axle **325** to the swing arm frame member **300** of the motorcycle.

[0042] An adjustment bore **130** is drilled in the extended member to accept an adjustment stud **125**. The adjustment stud is centered on the width dimension  $W_1$  of the adjustment plate **105** and essentially centered in the height dimension of the extended member. This location must be set such that the adjustment stud **125** can contact the end of the fork of the swing arm frame member. The adjustment bore **130** has a diameter that can accommodate a captivated nut **135**. Alternately, if the adjustment bore is to be threaded, the adjustment bore **130** must be the diameter of the adjustment stud **125**. In the preferred embodiment,

the adjustment stud is approximately 8mm in diameter. If the captivated nut **135** is employed, the adjustment bore is approximately 0.50" in diameter or of a sufficient diameter to permit a press fit of the captivated nut **135**.

[0043] A securing lock nut **140** is threaded on to the adjustment stud **125**. When  
5 the driven wheel is coupled to the forks of the swing arm frame member, the  
securing lock nut **140** is unthreaded on the adjustment stud **125**. When the  
driven wheel is placed between the forks of the swing arm frame member and set  
to tension the chain to a preliminary tension, the axle nuts are tightened to hold  
the placement of the driven wheel. The adjustment stud **125** is then adjusted to  
10 align axle the driven wheel within the swing arm frame member. The securing  
lock nut **140** is threaded to impinge upon the extending member **110** of the  
adjustment plate **105** and lock the adjustment stud **125** in place.

[0044] The guide marks **145** are placed on the top and bottom surfaces of the  
adjustment plate **105** and are aligned with the center of the axle bore **115**. The  
15 fork of the swing arm frame member will have multiple marks or a similar  
calibration mark to allow the axle of the driven wheel to be correctly aligned  
during the movement to tension the chain. The guide marks **145** are shown at  
the top and bottom of the adjustment plate **105** but may also be on the front face  
of the adjustment plate **105**.

20 [0045] The guide marks **45** (Figs.1a -1c) and **145** (Figs.2a -2d) are shown as  
single guide marks with multiple calibration marks being present on the fork of  
the swing arm frame member. Figs. 3a and 3b illustrate the first chain tensioner

of Figs. 1a -1c with multiple guide marks **245**. In this instance, the forks of the swing arm frame member have single calibration reference marks for assisting in the aligning of the axle within the swing arm frame member.

[0046] Refer now to Figs. 4 and 5 for a discussion of the placement, installation, and operation of the chain tension adjusting device of this invention. The driven wheel **305** has an axle **325** that is placed between the forks **302** and **304** of the swing arm frame member **300** of the motorcycle. A chain (not shown) is placed on a sprocket **360**. The ends of the wheel hub **310** are placed in an axle slot of **345** in each fork **302** and **304** of the swing arm frame member **300**. The first chain tensioner **330** is placed on the end of the wheel hub **310** and in the guide recess **340** of one fork **304** of the swing arm frame member **300**. Similarly the second chain tensioner **320** is placed on the end of the wheel hub **310** and in the guide recess of the second fork **302** of the swing arm frame member. The driven wheel **305** is moved until the chain has a preliminary tension. The first adjustment plate **5** is moved within the guide recess **340** until the extending member is aligned with the end of the fork **304**. The adjustment securing nut **40** is rotated to allow the first adjustment stud **25** to be rotated such that it is in contact with the end of the fork **304**. Similarly, the second adjustment plate **105** is moved within the guide recess (equivalent to the guide recess **340** of fork **304**) until the extending member is aligned with the end of the fork **302**. The adjustment securing nut **140** is rotated to allow the first adjustment stud **125** to be rotated such that it is in contact with the end of the fork **302**.



[0047]        The axle **325** is secured within the capturing recess **20** (Figs. 1a – 1c) and the axle nut **315** is tightened to secure the driven wheel between the forks **302** and **304** of the swing arm frame member **300**. The adjustment stud **25** is then rotated to pull the wheel hub **310** and thus increase tension on the chain until a final tension is achieved. The placement of the guide mark **45** relative to a calibration reference mark **355** on the fork **304** is noted. The adjustment stud **125** is then rotated to pull the end of the wheel hub **310** until the reference mark **145** is aligned with the calibration reference mark **355** of the fork **302**. The securing nuts **40** and **140** are rotated until they have respectively impinged upon the extending members **10** and **110** thus securing the adjustment studs from movement during operation of the motorcycle.

[0048]        The first and second adjustment plates **5** and **105**, in the preferred embodiment, are formed of an aircraft grade aluminum. Conversely, the materials for the first and second adjustment plates **5** and **105** may be steel, titanium, carbon epoxy or other suitable material that can withstand the conditions of operation at the axel of a motorcycle and the tension of the chain.

[0049]        In the preferred embodiment of this invention as described, the flexible power transmission mechanism is a chain. The chain is engaged with the teeth of a sprocket coupled to the driven wheel. However, in an alternate embodiment of this invention, the flexible power transmission mechanism is a belt and the belt is placed on a pulley coupled to the driven wheel.

[0050]        While this invention has been particularly shown and described with reference to the preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made without departing from the spirit and scope of the invention.

5    [0051]        The invention claimed is: